DOE/NSF Project Manager's Quarterly Progress Report
U.S. Large Hadron Collider Project

1. PROJECT IDENTIFIERS

Reporting Period:	Through **June 30, 1999**
Program Sponsors:	DOE High Energy Physics Division/NSF Physics Division
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2. PROJECT DESCRIPTION

The Department of Energy (DOE) and the National Science Foundation (NSF) have signed agreements committing to collaboration in the construction of the Large Hadron Collider (LHC) at CERN (European Laboratory for Particle Physics) and two of its associated detectors. The U.S. fabrication effort will be carried out at, or under the supervision of, U.S. universities and national laboratories under the terms and conditions described in the International Collaboration Agreement (Agreement) and its Accelerator and Experiments Protocols. The U.S. LHC Project is defined by the goods and services to be provided to CERN under the terms of the Agreement between DOE, NSF, and CERN. These goods and services include DOE contributions to the LHC accelerator, and DOE and NSF contributions to the ATLAS (A Toroidal LHC Apparatus) and CMS (Compact Muon Solenoid) experiments.

The DOE contribution to the LHC accelerator consists of items provided by DOE National Laboratories and CERN direct purchases from U.S. industrial firms. The scope of these contributions is addressed in the Accelerator Protocol and described in detail in an Implementing Arrangement between the collaborating DOE National Laboratories and CERN. The DOE and NSF contributions to the ATLAS and CMS detectors consist of items supplied by the collaborating U.S. universities and DOE National Laboratories. The scope of these contributions is addressed in the Experiments Protocol and described in detail in Memoranda of Understanding for collaboration on construction of each experiment.

The U.S. LHC Project includes the U.S. ATLAS, U.S. CMS, and U.S. LHC Accelerator projects. This report summarizes the overall status of the U.S. LHC Project effort and includes status specific to each sub-project. Additional information can be accessed at the following web sites:

U.S. LHC Project - http://www.hep.net/doe-hep/lhc.html

LHC Project - http://wwwlhc.cern.ch/	U.S. LHC Accelerator - http://www-td.fnal.gov/
ATLAS - http://atlasinfo.cern.ch/Atlas/Welcome.html	U.S. ATLAS - http://www.usatlas.bnl.gov/
CMS - http://cmsinfo.cern.ch/Welcome.html	U.S. CMS - http://uscms.fnal.gov/

3. PROJECT MANAGER'S NARRATIVE HIGHLIGHTS

A listing of current project reviews and status meetings is shown below:

Project	Event	Date
U.S. LHC Accelerator	Quarterly Status Meeting	July 13, 1999
U.S. ATLAS	Quarterly Status Meeting	August 6, 1999
U.S. CMS	DOE/NSF Review	August 19, 1999
U.S. LHC Accelerator	DOE/NSF Review	October 19-20, 1999
U.S. ATLAS	Quarterly Status Meeting	December 1, 1999
U.S. CMS	Quarterly Status Meeting	December 15, 1999 (tbd)

The results of these activities are documented in formal reports and meeting notes. The U.S. CMS and U.S. ATLAS projects submit monthly cost and schedule performance data to DOE/NSF and the U.S. LHC Accelerator project submits a quarterly report. Current performance data is summarized below.

Table 3.1, Contingency Status (in thousands of dollars)[*]

U.S. Activity	Total Project Cost TPC	Budget at Completion BAC	Contingency	BCWP	BAC-BCWP	Contingency / BAC-BCWP (%)
ATLAS[†]	163,750	100,057	43,918	17,464	82,593	53.2
CMS	167,250	119,040	48,210	32,870	86,170	55.9
Accelerator	110,000	91,455	18,545	30,424	61,031	30.4

Table 3.2, Schedule Performance Indices[‡]

	Planned Complete (%)	Actual Complete (%)	Schedule Performance
U.S. ATLAS	20.6	17.5	0.85
U.S. CMS	30.6	27.6	0.90
U.S. LHC Accelerator	36.9	33.2	0.90

Contracts for materials are typically below estimates, labor costs are close to plans, and contingency is adequate. The detector projects are now beginning the production phase. During this phase cost experience on production labor will be an important indicator of cost performance. Schedule performance is measured through milestone completion and by earned value (budgeted cost of work performed). These measurements indicate that schedule progress is slightly behind plans.

[*] BCWP = Budgeted Cost of Work Performed. BAC = Budget at Completion.
[†] The Budget at Completion for U.S. ATLAS excludes $19,776k for items that have no cost risk or capped.
[‡] Planned complete = Budget Cost of Work Scheduled (BCWS)/Budget At Completion (BAC). Actual complete = BCWP/BAC. Schedule performance = BCWP/BCWS.

4. PROJECT MANAGER'S ASSESSMENT

The U.S. ATLAS and CMS groups are meeting their project goals and are reliable and influential partners in the ATLAS and CMS collaborations. There is a strong relationship between the U.S. labs and CERN on the machine with good success resolving interface issues.

Cost & Schedule - Project reviews and reports confirm that the projects have adequate contingency available. Cost performance is in accordance with plans. CERN expects to complete construction of the LHC and commence initial operations in 2005. The U.S. schedules are generally consistent with the ATLAS, CMS, and LHC schedules. Near term schedule progress is satisfactory, typically within fifteen percent of the approved plan.

Technical - Considerable effort was directed at defining a set of U.S. deliverables to CERN that we are confident can be realized, given the planned funding. The U.S. ATLAS, U.S. CMS, and U.S. LHC Accelerator projects have each developed a separate list of deliverables that has been formally accepted by CERN, and the DOE/NSF Joint Oversight Group. We expect to fulfill our commitments to CERN and hope that additional items can be provided to CERN, within the approved funding, should cost performance be favorable.

Issues

LHC Machine Schedule - CERN continues to maintain that the machine completion schedule is still viable with machine commissioning/first physics run in the summer of 2005. This goal has become more challenging due to schedule delays in the industrial magnet production program. There should be a better sense of the schedule once industrial vendors are routinely producing superconducting magnets that meet the LHC performance requirements.

ATLAS and CMS Schedules - The U.S. detector activities often depend on progress by their international counterparts. There are instances where delays in the international ATLAS and CMS experiments have caused adverse schedule impacts to the U.S. activities. The U.S. managers and the CMS and ATLAS Spokespersons are aware of these schedule conflicts and are attempting to address these issues on a case-by-case basis.

Russian Collaborators - Russian collaborators continue to face severe difficulties due to the financial crisis in Russia. CERN and ATLAS and CMS management are monitoring this issue in order to mitigate impacts on the LHC program. Since some of the U.S. ATLAS and U.S. CMS detector activities are dependent on Russian collaborators, U.S. managers are taking steps to assure that the U.S. deliverables are not adversely impacted by the funding situation in Russia.

ATLAS Integration – The resources available for ATLAS integration engineering are insufficient to meet schedule and technical assurance requirements. This issue has been brought to the attention of CERN management.

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5. NARRATIVE SUMMARY

5.1 DETECTORS

U.S. ATLAS

ATLAS International – The ATLAS Spokesperson, Peter Jenni, addressed the status of the overall ATLAS experiment at a recent DOE/NSF review of U.S. ATLAS in May 1999. P. Jenni indicated that there a number of areas where the schedules are now critical and corrective action is necessary. Noteworthy items are summarized below:

- There has been an impressive effort to improve the schedule for the ATLAS barrel toroid magnet. This magnet is not only a considerable technical challenge but is also schedule critical.
- Plans are being developed to integrate the ATLAS solenoid magnet into the liquid argon barrel cryostat in Japan instead of at CERN as originally planned. Since the U.S. is responsible for the barrel cryostat we are actively involved in the development of this plan.
- The cash flow from the Russian government is below agreed values but ATLAS has found ways to avoid delays. There is good progress on the scintillator for the tile calorimeter (25% of the requirement).
- The muon system passed a production readiness review and the end plugs for the drift tubes are in production.
- The liquid argon system has experience several schedule delays and is now receiving increased attention from the ATLAS Technical Coordination Group and CERN.

U.S. ATLAS - A DOE/NSF review was held in May 1999. The project is making good progress and 18% of the technical baseline is complete. Noteworthy items are summarized below:

- The **Silicon Strip and Pixel** detector managers continue to report interesting results and a number of problems. This is an ambitious and diverse subsystem that pushes the frontier of technology more than any other detector in ATLAS. Additional iterations of the designs/prototypes of the microelectronics are required with associated schedule delays.
- The **Transition Radiation Tracker** managers recently satisfied action items resulting from the December Production Readiness Review. The "straw" production and testing continues to progress well at Hampton University.
- The **Liquid Argon Electromagnetic Calorimeter** barrel cryostat fabrication is progressing well. KEK in Japan has requested permission to integrate the solenoid with the barrel cryostat in Japan. The readout electrodes are under contract with increased management attention by the ATLAS technical coordinator and CERN management.
- The submodule production rates for the **Tile Hadronic Calorimeter** are quite favorable with three sites in production.
- The **Muon Tracking** detector passed a Production Readiness Review and the procurement for the end plugs is launched.
- The **Trigger and Data Acquisition Subsystems** are progressing according to plans.

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U.S. CMS

CMS International - The CMS Technical Coordinator, Alain Herve, presented the status of CMS to DOE/NSF staff at a recent quarterly status meeting. The solenoid magnet and civil construction work is proceeding on schedule. Noteworthy items are summarized below:

- The solenoid magnet is on budget and schedule. However, there is an important contract for the coil winding that will be awarded this fall. Once this contract is in place there 70% of the total magnet cost will be committed and the overall schedule will be fixed.
- Fabrication work on the magnet barrel yoke and muon end cap steel is progressing well.
- Milestone reporting is in place (Level 1, 2, and 3). The next Level 1 milestone, Surface Hall Ready, is forecasted as on schedule for January 2000.
- CMS has evaluated the risk of funding shortfalls from collaborating countries. Current estimates project about 17 million Swiss Francs in deliverable values which corresponds to about 30 million dollars in U.S. accounting (includes labor). The collaboration is developing contingency plans for addressing the projected shortfall.
- There is a roadmap for decisions on the CMS central tracker. The development of present baseline technology of micro-strip gas chambers (MSGCs) has not gone well and there is a plan to evaluate the results this fall and decide on whether to continue with the MSGCs are switch to silicon strip detector technology.

U.S. CMS - The U.S. CMS project is making good progress and is approximately 28% complete. The project is modifying the methodology for determining earned value on large contracts. The current practice has been to take full credit upon contract award thereby overstating schedule performance. The new method measures progress on an incremental basis. Cost experience on material contracts is good. Noteworthy items are summarized below:

- The U.S. has management responsibility for the **Hadron Calorimeter (HCAL)** which passed two Engineering Design Reviews in June, Endcap and Outer Barrel calorimeter.
- The **Endcap Muon** system has begun full-scale production of the cathode panels for the cathode strip chambers. In response to the 1998 test beam results, the application specific integrated circuit chips were resubmitted to the vendor for additional iteration. These chips are back and will be included in the CERN test beam cycle this year.
- 1000 avalanche photodiodes from Hamamatsu for the **Electromagnetic Calorimeter** were received, tested, and characterized. Problems with radiation hardness are being addressed through work on an alternative design.
- **Common Project** responsibilities now include CMS magnet superconductor, aluminum stabilizer, and bulk aluminum. Fermilab awarded contracts for the superconductor to two firms, one U.S. and one European. Once the aluminum contracts are in place the U.S. responsibilities for common projects will be satisfied.
- DOE has advanced an additional $6.3 million in budget authority to U.S. CMS for the current fiscal year. These funds had been planned for the CERN direct purchases. U.S. CMS has used the funds to lock in favorable prices on material contracts.
- Ed Temple, U.S. CMS Construction Project Manager (CPM), is now working with the Spallation Neutron Source project at Oak Ridge National Laboratory. Dan Green, U.S. CMS Technical Director, is now responsible for the CPM duties.

5.2 U.S LHC ACCELERATOR

A DOE/NSF status review was held in April. The project is making good progress and is approximately 33% complete. The quench performance of the last two models of the interaction region quadrupole magnets show adequate quench performance and considerable improvement over previous models. Noteworthy items are summarized below:

- The Interaction Region (IR) Quadrupole magnet R&D program is nearing completion. Recent models exhibit adequate quench and magnetic field quality performance.
- CERN has selected a mixed configuration of Fermilab and KEK magnets for the IRs. The schedule for KEK magnets is later than required and CERN is working the issue.
- Structural testing of the cryostat support is underway at Fermilab.
- All four heat exchanger modules are at Fermilab and the feed can is being fabricated.
- Short prototype twin-aperture dipole construction began a month ahead of schedule.
- An additional spare dipole magnet will be required due to changes in the aperture spacing of the D2 dipoles.
- The first of two planned reviews of the interface drawings was held at the end of June.
- Progress on the design of the IR absorbers has been slowed pending resolution of a number of interface issues.
- Upgrades to the superconductor test facility at BNL are nearly finished.
- All of the promised cable measuring heads equipment has been delivered to CERN.
- A workshop on LHC IR correction systems was held at BNL and an agreement was reached on the IR corrector requirements.
- Analytic and simulation calculations of electron cloud effects are being validated by comparison with observations in existing electron and positron machines.

5.3 CERN DIRECT PURCHASES

DOE receives invoices from CERN for reimbursement of their payments to U.S. vendors as called for in the U.S.-CERN Agreement and Accelerator Protocol. The status of DOE payments to CERN is shown in Table 5.3.

Table 5.3, CERN Direct Purchases

Contract Item	U.S. Company	Amount Paid in $k	Contract Value
Niobium-titanium alloy bars and niobium barrier sheets	Wah Chang	6,749	
Dipole outerlayer and quadrupole superconducting cable [587 km]	IGC Advanced Superconductors	1,151	
Totals		7,900	

6. FINANCIAL/COST STATUS AND PLANS

TOTAL PROJECT FUNDING PLAN (then year millions of dollars)*

Fiscal Year	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	Total
Machine Funding Profiles (DOE)											
US LHC	2.00	6.67	14.00	15.40	20.10	17.80	17.00	10.20	6.83	0.00	110.00
CERN Direct	0.00	0.00	0.00	8.04	14.10	17.56	14.20	18.80	17.30	0.00	90.00
Machine Total	2.00	6.67	14.00	29.74	31.20	32.06	31.20	29.00	24.13	0.00	200.00
Detector Funding Profiles (DOE and NSF)											
US ATLAS	1.70	3.71	10.05	27.83	27.44	27.59	27.85	22.89	14.69	0.00	163.75
DOE	1.70	3.71	10.05	11.20	15.50	15.30	15.20	15.60	14.69	0.00	102.95
NSF	0.00	0.00	0.00	16.63	11.94	12.29	12.65	7.29	0.00	0.00	60.80
US CMS	2.30	4.62	10.95	29.58	24.26	23.42	27.81	22.83	15.18	0.00	167.25
DOE	2.30	4.62	10.95	30.36	20.30	19.34	23.60	20.40	15.18	0.00	147.05
NSF	0.00	0.00	0.00	5.52	3.96	4.08	4.21	2.43	0.00	0.00	20.20
Detectors Total	4.00	8.33	21.00	63.71	51.70	51.01	55.66	45.72	29.87	0.00	331.00

FUNDS, COSTS, & COMMITMENTS (cumulative in thousands of dollars)†

Project Element	A = Funds Allocated‡	B = Actual Costs	C = Open Commit.	D= B+C Total	A –D= Funds Available
U.S. ATLAS	43,290	16,793	2,365	19,158	24,132
U.S. CMS	53,750	23,810	23,796	47,606	6,144
U.S. LHC Accelerator	38,070	28,183	2,123	30,306	7,764
CERN Direct Purchases	8,040	7,900	0	7,900	140
U.S. LHC Total	143,150	76,686	28,284	104,970	38,180

COST AND SCHEDULE STATUS PERFORMANCE REPORT (thousands of dollars)

	Cumulative Costs to Date					At Completion		
	Budgeted Cost			Variance			Revised	
	Work Scheduled	Work Performed	Actual Cost	Schedule	Cost	Budgeted	Estimate	Variance
U.S. ATLAS	20,625	17,464	16,793	(3,161)	671	163,750	163,750	0
U.S. CMS	36,480	32,870	23,810	(3,610)	9,060§	167,250	167,250	0
U.S. LHC Accelerator	33,819	30,424	30,306	(3,395)	118	110,000	110,000	0
CERN Invoices	7,900	7,900	7,900	0	0	90,000	90,000	0
U.S. LHC Total	98,824	88,658	78,809	(10,166)	9,849	531,000	531,000	0

* The annual funding distribution for the U.S. LHC projects is subject to change. During the quarter U.S. CMS funding was increased in FY'99 by $6.3 million. This funding was originally planned for CERN Direct Purchases.
† The figures are based on financial reports from the U.S. ATLAS, CMS, and LHC Accelerator projects.
‡ NSF funding for FY 1999 was authorized last quarter for the U.S. ATLAS and U.S. CMS projects. This funding will be obligated in FY 1999 and FY 2000.
§ The large positive cost variance reported for U.S. CMS is due to delays in the submission of university invoices.

DOE/NSF COST BASELINE (in thousands of dollars)

U.S. ATLAS Cost Baseline*

WBS No.	Description	Previous	Change	Current
1.1	Silicon System	16,135	1,792	17,927
1.2	Transition Radiation Tracker	7,377	589	7,966
1.3	Liquid Argon Calorimeter	32,485	2,756	35,241
1.4	Tile Calorimeter	6,464	379	6,843
1.5	Muon Spectrometer	18,175	1,527	19,702
1.6	Trigger/Data Acquisition System	13,379	1,832	15,211
1.7	Common Projects	8,089	1,090	9,179
1.8	Education	251	(47)	204
1.9	Project Management	6,683	656	7,339
	Contingency	38,163	5,975	44,138
	Escalation (FY 1997 to as spent $)	16,549	(16,549)	0
	U.S. ATLAS Total Cost Baseline	163,750	0	163,750

U.S. CMS Cost Baseline

WBS No.	Description	Previous	Change	Current
1.1	Endcap Muon	26,206	729	26,935
1.2	Hadron Calorimeter	30,736	(254)	30,482
1.3	Trigger and Data Acquisition	12,382	(31)	12,351
1.4	Electromagnetic Calorimeter	7,969	(196)	7,773
1.5	Forward Pixels	5,176	96	5,272
1.6	Common Projects	23,874	0	23,874
1.7	Project Office	5,445	(12)	5,433
	Contingency	48,542	(332)	48,210
	FY 1996 & FY 1997 Expenditures	6,920	0	6,920
	U.S. CMS Total Cost Baseline	167,250	0	167,250

U.S. LHC Accelerator Cost Baseline

WBS No.	Description	Previous	Change	Current
1.1	Interaction Region Components	46,778	0	46,778
1.2	Radio Frequency Straight Section	13,492	0	13,492
1.3	Superconducting Wire and Cable	11,352	0	11,352
1.4	Accelerator Physics	4,925	0	4,925
1.5	Project Management	14,907	0	14,907
	Total in as spent $	91,455	0	91,455
	Contingency	18,545	0	18,545
	U.S. LHC Accelerator Total Cost Baseline	110,000	0	110,000

* The current baseline is now presented in as spent dollars. Previous reports addressed FY 1997 dollars.

7. SCHEDULE STATUS AND PLANS*

U.S. ATLAS Baseline Milestones (through 2001)

WBS Identifiers	Milestone Description	Baseline Date	Forecast (F)/ Actual (A)
1	Project Start	10/01/95	10/01/95 (A)
	Project Completion	09/30/05	09/30/05 (F)
Tile Cal	Start Submodule Procurement	09/01/97	09/01/97 (A)
Tile Cal	Technology Choice for F/E Electronics	11/15/97	11/15/97 (A)
LarCal	Cryostat Contract Award	07/24/98	08/05/98 (A)
LarCal	Barrel Feedthroughs Final Design Review	09/30/98	10/02/98 (A)
LarCal	FCAL Mechanical Design Complete	12/14/98	**08/15/99 (F)**
TRT	Mechanical Design Frozen	12/31/98	12/07/98 (A)
Muon	Start MDT Chambers Lines 1 and 3	01/04/99	**12/13/99 (F)**
Tile Cal	Start Module Construction	05/01/99	**08/23/99 (F)**
LarCal	Start Electronics Production (Preamps)	06/01/99	**11/01/99 (F)**
Muon	Start CSC Chamber Production	07/01/99	**11/15/99 (F)**
Tile Cal	Start Production Motherboards & Digitizer Boards	07/02/99	07/02/99 (F)
Silicon	Start Full Strip Module Production	10/15/99	**06/05/01 (F)**
Muon	ASD Chip Design Complete	10/29/99	10/29/99 (F)
LarCal	FE Board SCA Production Chip Submission	07/03/00	07/03/00 (F)
Tri/DAQ	Select Final LVL2 Architecture	12/31/99	12/31/99 (F)
LarCal	Level 1 Trigger Final Design Complete	03/01/00	03/01/00 (F)
Silicon	ROD Design Complete	04/14/00	**11/22/00 (F)**
Muon	Final Design Global Alignment Devices Complete	04/28/00	04/28/00 (F)
LarCal	ROD Final Design Complete	06/01/00	**06/01/01 (F)**
Muon	CSC IC Production Complete	06/30/00	06/30/00 (F)
TRT	Select Final Electrical Design	07/31/00	07/31/00 (F)
TRT	Start Production (Electrical)	07/31/00	**01/10/01 (F)**
LarCal	Motherboard System Production Complete	01/01/01	**06/01/01 (F)**
Muon	Kinematic Mount Design Complete	01/30/01	01/30/01 (F)
Silicon	Start Full Silicon Strip Electronics Production	03/30/01	03/30/01 (F)
LarCal	Cryostat Arrives at CERN	03/30/01	03/30/01 (F)
LarCal	Barrel Feedthroughs Production Complete	07/18/01	07/18/01 (F)
LarCal	FCAL-C Delivered to EC	09/03/01	09/03/01 (F)
Tri/DAQ	LVL2 Trigger Design Complete	12/31/01	12/31/01 (F)
Tri/DAQ	LVL2 Trigger Prototype Complete	12/31/01	09/30/01 (F)

* Items in bold denote changes and/or forecast dates that differ from the approved baseline.

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U.S. CMS Baseline Milestones*

WBS Identifiers	Milestone Description	Baseline Date	Forecast (F)/ Actual (A)
1	DOE/NSF CERN Agreement	12/97	12/08/98 (A)
	Approve Baseline	07/98	10/19/98 (A)
	Approve Project Management Plan	09/98	12/01/98 (A)
	U.S. CMS Project Complete	10/05	09/30/05 (F)
CP	Move 2nd Year Funding - Common Package (CP) A	10/98	01/99 (A)
EMU	Muon Cathode Strip Chamber (CSC) Factory Start	01/99	01/99 (A)
HCAL	HCAL Optics Factory Start	01/99	01/99 (A)
HCAL	1st 18 Wedges Optics @ CERN	06/00	06/00 (F)
HCAL	1st 18 Wedges HCAL Brass @ CERN	11/00	11/00 (F)
FPIX	Forward Pix Cooling Distribution Design Complete	01/01	01/01 (F)
CP	4th Year CP Package A Payment Complete	06/01	06/01 (F)
EMU	1st 17 Endcap Muon CSC Chambers Complete	06/01	06/01 (F)
HCAL	Finish Production Brass Wedges @ CERN	12/01	12/01 (F)
HCAL	Finish Production Optical System @ CERN	12/01	12/01 (F)
HCAL	HCAL Electronics Complete	01/02	01/02 (F)
ECAL	Final Production ECAL Serializer Wafer	02/02	02/02 (F)
TriDAS	Trigger MPC Board Assembly Complete	01/03	01/03 (F)
Inst	Start CMS Installation in Pit	01/03	01/03 (F)
CP	HE + YE + Connect	01/03	01/03 (F)
CP	HB in Vacuum Tank Test	03/03	03/03 (F)
CP	HE - YE – Connect	05/03	05/03 (F)
EMU	1st Half CSC Assembly at CERN Complete	07/03	07/03 (F)
TriDAS	Data Acquisition Event Manager Boards Complete	08/03	08/03 (F)
CP	Magnet Full Field Test Completed @ CERN	09/03	09/03 (F)
Inst	BO Underground Counting House	09/03	09/03 (F)
ECAL	Complete Production of Avalanche Photodiodes	09/03	09/03 (F)
Inst	Install Magnet in Collision Hall	10/03	10/03 (F)
EMU	All ME234/2 Assembled & Tested	10/03	10/03 (F)
EMU	EMU Electronics Complete	12/03	12/03 (F)
ECAL	Forward Pixels Shipped to CERN	09/04	09/04 (F)
All	U.S. CMS Construction Complete	09/04	09/04 (F)

* U.S. CMS is developing a revised list of Level 2 baseline milestones that correspond directly with official milestones tracked by the CERN LHC Committee (LHCC). This revised milestone list will be included in the next quarterly report.

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U.S. LHC Accelerator Baseline Milestones (through 2002+)

WBS Identifiers	Milestone Description	Baseline Date	Forecast (F)/ Actual (A)
1	Project Start	10/01/95	10/01/95 (A)
	Decision on RF Region Quadrupoles	07/01/01	07/01/01 (F)
	Project Completion	09/30/05	09/30/05 (F)
IR Region	Begin 1st Inner Triplet Quadrupole Model Magnet	07/01/97	07/01/97 (A)
SC	All Cable Production Support Equipment Delivered to CERN	09/01/99	**05/28/99 (A)**
SC	Complete Superconductor Test Facility Upgrades	06/01/99	**09/30/99 (F)**
RF Region	Begin Assembly of 1st Dipole Model Magnet	09/01/99	**06/10/99 (F)**
IR Region	Complete Inner Triplet Quadrupole Model Magnet Program Phase 1	12/01/99	12/01/99 (F)
IR Region	Complete Inner Triplet Quadrupole Model Magnet Program Phase 2	03/01/00	03/01/00 (F)
IR Region	Place Purchase Order for HTS Power Leads	02/01/00	02/01/00 (F)
RF Region	Complete Dipole Model Magnet Program	08/01/00	08/01/00 (F)
RF Region	Begin RF Region Dipole Production Assembly	09/01/00	09/01/00 (F)
IR Region	Begin Absorber Fabrication	11/01/00	11/01/00 (F)
IR Region	Complete Inner Triplet Quadrupole Prototype Magnet Program	12/01/00	12/01/00 (F)
IR Region	Begin Interaction Region Beam Separation Dipole Production Assembly	03/01/01	03/01/01 (F)
IR Region	Begin Inner Triplet Feedbox Fabrication	03/01/01	03/01/01 (F)
IR Region	Begin Inner Triplet Quadrupole Production Assembly	04/15/01	04/15/01 (F)
IR Region	Complete 1st Inner Triplet Quadrupole Magnet	11/01/01	11/01/01 (F)
RF Region	Delivery of D3, D4 for IR4 right	01/01/02	01/01/02 (F)
IR Region	Delivery of D2 for IR8 Left	04/01/02	04/01/02 (F)
IR Region	Complete Inner Triplet Feedbox Fabrication	05/01/02	05/01/02 (F)
IR Region	Delivery of All Inner Triplet System Components for IR8 Left (MQX, DFBX, D1)	10/01/02	10/01/02 (F)
RF Region	Complete RF Region Dipole Production Assembly	10/01/02	10/01/02 (F)
IR Region	Delivery of D2 for IR5 Left	11/01/02	11/01/02 (F)
RF Region	Delivery of D3, D4 for IR4 left	11/01/02	11/01/02 (F)
IR Region	Complete Absorber Fabrication	12/01/02	12/01/02 (F)
IR Region	Delivery of All Inner Triplet System Components for IR8 Right (MQX, DFBX, D1)	01/01/03	01/01/03 (F)
IR Region	Delivery of D2 for IR8 Right	02/01/03	02/01/03 (F)
IR Region	Complete Interaction Region Dipole Production Assembly	03/01/03	03/01/03 (F)

8. TECHNICAL BASELINE STATUS

U.S. ATLAS

The U.S. ATLAS collaboration defined a list of initial deliverables representing the U.S. contribution to ATLAS. This list was approved by the JOG in March 1998 and sent to the CERN Director of Research in April 1998. Additional deliverables have already been identified as potential future contributions, should cost performance permit. Reference the U.S. ATLAS Project Management Plan, Appendix 3, (Approved 3/18/98).

U.S. CMS

The U.S. CMS collaboration defined a list of deliverables representing the U.S. contribution to CMS. This list was sent to the CERN Director of Research in August 1998 and approved by the JOG in October 1998. Reference the U.S. CMS Project Management Plan, Appendix 2, (Approved 10/19/98).

U.S. LHC Machine

U.S. LHC Accelerator Project - The U.S. deliverables to CERN are defined in the Implementing Arrangement to the Accelerator Protocol. The Implementing Arrangement was signed by the CERN and U.S. signatories in July 1998. Reference the U.S. LHC Accelerator Project Management Plan, Annex II, (Approved 6/15/98).

CERN Direct Purchases - CERN will procure from U.S. industrial firms supplies required to construct the LHC accelerator. These supplies will include superconducting alloy, cable, insulation, and other materials.

9. BASELINE CHANGE ACTIVITY

Baseline Control Level	Baseline Change Description
Level 1, DOE/NSF Joint Oversight Group	No changes this quarter
Level 2, DOE/NSF Project Office	
U.S. ATLAS	Changes approved this quarter.
U.S. CMS	Changes reported this quarter.
U.S. LHC Accelerator Project	None reported this quarter.

U.S. ATLAS – A total of two Level 2 changes were approved this quarter. The primary change was the conversion from fiscal year 1997 dollars to as spent dollars.

U.S. CMS – There were changes to seven elements of the Level 2 cost baseline this quarter. The major change occurred in the endcap muon system due to revised estimates for cathode strip production. The net use of contingency for these changes was $333 thousand.

U.S. LHC Accelerator – There were no changes to the Level 2 cost baseline this quarter.

APPENDIX A - FUNDING BY INSTITUTION (in thousands of dollars)

U.S. CMS

Institution	U.S. CMS Total FY 1998				U.S. CMS Total FY 1999* (as of 6/30/99)			
	DOE		NSF	Total	DOE		NSF	Total
	Grant	Contract			Grant	Contract		
FNAL	0	5,517	0	5,517	0	10,817	40	10,857
Faifield U.	0	29	0	29	0	0	0	0
U. of Maryland	90	65	0	155	0	132	131	263
Boston U.	0	32	0	32	31	111	0	142
Florida State U.	60	54	0	114	71	118	0	189
U. of Minnesota	60	95	0	155	161	452	0	613
U. of Iowa	77	62	0	139	20	5	0	25
U. of Rochester	127	1,159	0	1,286	262	485	0	747
Notre Dame	0	52	0	52	0	44	184	228
Purdue U.	38	135	0	173	49	166	0	215
U of Miss.	46	100	0	146	68	91	0	159
U. of Florida	44	95	0	139	184	412	0	596
Ohio State U.	140	64	0	204	275	212	0	487
Carnegie M.	0	113	0	113	0	291	0	291
Rice U.	138	19	0	157	102	56	0	158
U. of Wisconsin	533	1,052	0	1,585	471	3,598	0	4,069
U. C. Davis	34	100	0	134	0	78	0	78
UCLA	150	87	0	237	249	173	0	422
U.C. Riverside	20	10	0	30	0	164	0	164
John Hopkins	0	29	0	29	0	0	[70]	70
Northwestern	0	59	0	59	5	26	0	31
Rutgers	0	13	0	13	0	0	34	34
Princeton	0	256	0	256	0	626	0	626
Caltech	0	148	0	148	0	458	0	458
U.C. San Diego	11	0	0	11	90	24	0	114
Northeastern	0	0	0	0	0	0	3,370	3,370
U. Ill. –Chicago	0	0	0	0	0	0	124	124
U. of Nebraska	0	0	0	0	0	0	[24]	24
MIT	0	37	0	37	15	67	0	82
Iowa State U.	0	0	0	0	0	0	19	19
Reserve	0	0	0	0	0	3,401	1,524	4,925
Total	1,568	9,382	0	10,950	2,053	22,007	5,520	29,580

* FY 1999 totals show all current plans. Allocations pending signed statements of work are shown in brackets.

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U.S. ATLAS

Institution	U.S. ATLAS Total FY 1998				U.S. ATLAS Total FY 1999 (as of 6/30/99)			
	DOE		NSF	Total	DOE		NSF	Total
	Grant	Contract			Grant	Contract		
ANL	0	1,098	0	1,098	0	967	0	967
BNL	0	3,903	0	3,903	0	2,481	0	2,481
LBNL	0	633	0	633	0	551	0	551
SUNY/Albany	20	0	0	20	48	0	0	48
U. of Arizona	320	100	0	420	634	0	0	634
Boston U.	224	0	0	224	298	0	0	298
Brandeis U.	265	45	0	310	0	0	499	499
U.C. Irvine	193	0	0	193	0	0	0	0
U.C. SantaCruz	404	0	0	404	63	0	0	63
U. of Chicago	0	54	0	54	0	0	1,069	1,069
Duke U.	190	0	0	190	507	0	0	507
Hampton U.	0	0	0	0	0	0	538	538
Harvard	234	0	0	234	0	0	500	500
U. of Illinois	50	159	0	209	347	0	0	347
Indiana U.	190	0	0	190	640	0	0	640
MIT	50	0	0	50	105	0	0	105
Michigan State	0	35	0	35	0	0	178	178
Nevis/Columbia	0	675	0	675	0	0	2,427	2,427
U. of New Mex.	20	0	0	20	30	0	0	30
Northern Illinois	0	0	0	0	0	0	0	0
Ohio State U.	0	0	0	0	100	0	0	100
U. of Michigan	62	254	0	316	716	0	0	716
U. of Oklahoma	30	0	0	30	0	0	41	41
U. of Penn.	250	0	0	250	300	0	0	300
U. of Pittsburg	110	0	0	110	0	0	150	150
U. of Rochester	0	0	0	0	0	0	3,587	3,587
U.T. Arlington	50	82	0	132	0	0	474	474
S. Methodist	40	0	0	40	124	0	0	124
SUNY/Stony B.	27	0	0	27	0	0	1,045	1,045
Tufts University	50	0	0	50	20	0	0	20
U. Washington	0	0	0	0	0	0	0	0
U. of Wisconsin	230	0	0	230	429	0	0	429
Total	3,009	7,038	0	10,047	4,361	3,999	10,508	18,868
Reserve	0	3	0	3	0	1,477	7,486	8,963
Total	3,009	7,041	0	10,050	4,361	5,476	17,994	27,831

U.S. LHC Accelerator

	U.S. LHC Accelerator FY 1998	U.S. LHC Accelerator FY 1999
FNAL	4,304	5,320
BNL	3,999	5,750
LBNL	2,140	1,110
Reserve	0	3,220
Total	10,443	15,400